



PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements relating to Ball Joints

We, ENGINEERING PRODUCTIONS (CLEVEDON) LIMITED, a British Company, of Clevedon, Somerset, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to ball joints of the type incorporating a ball element mounted to swivel in an outer housing having one open end arranged to receive a closure member and having the opposite end inwardly shouldered to form an open mouth through which a pin on the ball element rockably projects.

A main object of the invention is to provide a generally improved method of making a ball joint of the aforementioned type, as well as an improved ball joint resulting from such method.

Accordingly, the invention provides a method of making a ball joint of the type specified wherein low friction synthetic plastics bearing material is injection moulded between the housing and ball element, whilst the latter are held in their correct relative assembly positions, to form a seating socket in the housing around the ball element, and the said closure member is applied to the open housing end behind the socket, after the latter has set, to confine the socket between the closure member and the mouth shoulder under a compressive force sufficient to pre-load the joint.

In order that the invention may be clearly understood and readily carried into effect, a number of embodiments thereof will now be described in detail with reference to the accompanying drawings which show, by way of example, cross-sectional views, of six alternative forms of ball joint which may be constructed by the method of the invention, the end closures on all the ball joints being shown in exploded relationship to the joint housings and die parts for forming the joint sockets being indicated in chain-dotted lines.

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Referring now to the drawings, in which like parts are given the same references throughout, a ball joint is shown in Figure 1 having an outer housing 1 in the form of a ring or collar, one open end of which is arranged to receive an end closure member 2, whilst the opposite open end is inwardly shouldered at 1a to form a restricted mouth. A ball element 3, having a ball pin 4 projecting integrally therefrom, is arranged to seat within the housing in a seating socket 5 with the ball pin 4 projecting through the housing mouth and through the socket mouth which registers with the housing mouth.

To make such a joint in accordance with the method of the invention, the ball element 3 and housing 1 are first assembled and secured in a moulding apparatus in their correct relative positions. An annular die or plug 6 is arranged around the ball pin 4 to close off the housing mouth between the innermost edge of the mouth shoulder 1a and the periphery of the ball element adjacent the root end of the pin. A further die or plug 7 having an injection moulding orifice 8 opening through a working face thereof, is similarly arranged to cover the closable end of the housing remote from the mouth, this injection die 7 being located against an internal ledge 9 provided within the housing at the closable end thereof.

Low friction synthetic plastics bearing material is then injected through the die orifice 8 to form the seating socket 5 *in situ*. The injected material may, for example, be any thermoplastic having low friction and good wearing properties such as nylon or polypropylene, or any of the poly iso-cyanate condensation products, or may be a material incorporating polytetrafluoroethylene.

The mouth end 5a of the socket will, of course, be given the required form by suitable shaping of the operative end edge of the annular die or plug 6, so that the inwardly directed edges of the socket mouth and hous-

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ing mouth shoulder are flush with one another and diverge outwardly at an angle dependent upon the desired swing of the ball pin. The shoulder 1a around the housing mouth may also

5 be internally recessed so that projections are formed around the socket mouth, during the injection moulding, which enter the recesses and prevent relative rotation between the socket and housing.

10 The form of the socket end remote from the mouth and adjacent the die 7, will, of course, be determined by the shaping of the working face of the injection die 7. In the present example, the external surface of the

15 socket end remote from the mouth is provided with a flat margin 7a therearound which lies substantially flush with the aforesaid locating ledge 9 within the housing. The closed socket end may then be provided with a central part-

20 spherical portion 7b which bulges outwardly beyond the housing ledge in conformity with the spherical end of the ball element remote from the pin.

25 When the seating socket has had time to cool and set, the joint is completed by the application of the closure member 2 to the housing end remote from the mouth. This closure member is conveniently in the form of a plate as shown having a flat rim and a part-

30 spherical centre section, and is positioned behind the closed socket end with the plate rim located on the aforesaid ledge 9 within the housing. The plate is secured by peening over the housing rim therebehind, or in any

35 other convenient manner. When the plate is positioned the seating socket 5 is confined between the plate and the shoulder of the housing mouth, under a compressive force which can be determined by the form of the

40 plate. In this way, the joint can be pre-loaded to any desired extent.

In place of the plate 2 as illustrated, it will be appreciated that a screw-in plug or any other form of closure member could

45 equally well be applied to pre-load the joint after the socket has had time to cool and set. If a screw plug is employed the housing 1 will, of course, be appropriately modified to provide screwthreads to engage the plug.

50 By the described method, it is possible to obviate many difficulties in the manufacture of ball joints due to causes such as shrinkage or tolerance on the ball diameter or within the housing bore. At the same time, any desired

55 extent of pre-load can very readily be achieved whilst the largest possible seating surface on the ball may be employed.

A ball joint such as described has various uses, one such use being in the steering rod assembly of a motor vehicle. When thus used,

60 the collar-shaped housing may conveniently be formed integrally on one end of a steering rod part 1b as shown.

65 A modification of the method of the invention is exemplified by the ball joint shown

in Figure 2. This ball joint has a slightly modified outer housing 10 which again is generally in the form of a ring or collar and has one end inwardly shouldered at 10a to form a restricted mouth through which the ball pin 4 on a ball element 3a projects. This ball element is also slightly modified in having a flat opposite the ball pin. Again the housing is conveniently formed integrally on one end of a steering rod part 10b and has a seating socket 11 therein for the ball element 3a.

To make such a joint, a pre-formed washer 12 is first entered into the housing 10, through the housing end remote from the mouth, and is located against housing shoulder 10a. The ball element and housing are then, as in the previous example, assembled and secured in a moulding apparatus in their correct relative positions. With the ball element and housing thus assembled, the washer 12 forms a stop or closure around the mouth of the housing whilst injection moulding takes place. The washer, which may be made of nylon or other appropriate low friction plastics material, is retained in the housing when the joint is completed. To this end the washer is shaped to provide an inner seating edge which makes wiping contact around the ball element 3a near the root end of the ball pin 4, and an angled outer edge which seats snugly under the shoulder 10a of the housing mouth. The exposed upper edge of the washer 12 is made outwardly divergent to lie flush with an outwardly diverging inner edge of the housing mouth shoulder. The washer 12 additionally provides a seal around the housing mouth which excludes, or helps to exclude, dust or dirt from the working surfaces of the joint.

Injection moulding is effected through an injection orifice 8a in a die or plug 7c covering the closable housing end remote from the mouth, the die or plug 7c being located against the internal housing ledge 9 which eventually receives end closure member 13. Again the form of the closed end of the socket adjacent the die 7c will depend upon the formation of the working face of the die or plug 7c. In this example, the socket may have a flattened outer end surface with a central aperture in register with the flattened end of the ball element opposite the ball pin.

The closure member 13, applied after the socket has set, in this example may take the form of a flat plate as shown secured by peening over a housing rim part, or may take any other convenient form. Again the socket will be confined between the shoulder of the housing mouth, through the intermediary of the washer insert 12, and the closure member, the compressive force which the closure member is arranged to apply to the socket being selected according to the required pre-loading.

A further slightly modified ball joint produced by the method of the invention is shown

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in Figure 3, a washer insert 12 being again employed in conjunction with a housing ring 1 similar to that shown in the embodiment of Figure 1. In this ball joint, a seating socket 14 is provided with a closed end having a flattened outer surface which lies slightly proud of the locating ledge within the housing. The socket is moulded in a manner similar to that described in conjunction with Figure 2 with the aid of a lower die 7d having the injection moulding orifice 8 formed centrally therethrough. The end closure member 13 is again conveniently in the form of a flat plate which is secured in position over the open housing end behind the socket, after the latter has set, to confine the socket under compression between the mouth shoulder 1a, with the intermediary of the washer insert 12, and the plate 13. In this or any of the described embodiments, a flexible dust excluder sleeve such as 15 may be provided around the housing mouth and projecting ball pin 4.

In Figure 4, the ball joint embodiment produced by the method of the invention is substantially the same as the embodiment of Figure 3 except that a housing ring 10 is employed and a different washer insert 16. This insert 16 in the embodiment of Figure 4 takes the form of an integral rim on one end of a flexible sleeve-type dust excluder 17, the other end of which embraces the projecting ball pin 4. This excluder may be made of polyurethane, or any other appropriate material. Otherwise, the socket lining is injection moulded as previously described, the socket having a closed end remote from the mouth with a flattened outer surface which lies slightly proud of the locating ledge 9 within the housing. Again the end closure member may take the form of a plate 13 which is secured by peening over the housing rim to press against the closed socket end.

As shown in Figure 5, a further ball joint embodiment made by the method of the invention has parts similar to Figure 2 except that a fully rounded ball element is employed. In this embodiment also, an injection plug 7e is employed which penetrates the open housing end beyond the ledge 9 therein and is arranged to provide a socket 18 with a closed end remote from the housing mouth. A deformable disc insert 19 is then arranged for insertion into the housing behind the socket to transmit pressure from closure member 13 to the socket.

The embodiment of Figure 6 is similar to the embodiment of Figure 5 and is made in the same way except that a slightly modified lower die 7f is used. This lower die is shaped to provide the closed end of socket 20 with an outstanding rim and a spring insert 21 is arranged to press on the back of the socket within this rim. Behind the spring, a closure member 22 is employed having a generally

frusto-conical wall part with a flat rim 22a for seating on housing ledge 9.

As will be appreciated, the precise form of various ball joint parts as illustrated may be modified or interchanged without departing from the method of the invention. Thus, for example, an end closure member such as 22 shown in Figure 6 is clearly interchangeable with an end closure member such as 2 as shown in Figure 1. Equally, any of the socket ends remote from the socket mouth may be made wholly closed or with a centre opening, and such ends could also be provided with outstanding projections to receive pressure from the end closure member. Equally, inserts such as 19 could be arranged to provide spring pressure between any end closure member and the back of the socket.

Any of the joints shown may also have a conventional form of dust excluder sleeve, may have a modified sleeve formed integrally with the washer insert as described, or may rely solely on such inserts for excluding dust and dirt. Again, any of the closure plates could be of the screw-in type or could be formed or retained in any other appropriate manner.

The method of the invention may further include the use of a woven material, incorporating polytetrafluoroethylene if desired, which can be placed around any of the ball elements shown in the manner of a sock, either before or after the ball is placed in the housing. The plastic seating can then be moulded around this woven material to form a backing therefor. Furthermore, in any of the described joints, lubricant can be inserted before the closure member is fitted and equally any of the socket seatings can be made with any desired passages therethrough to permit such lubricant to reach the surface of the ball element.

WHAT WE CLAIM IS:—

1. A method of making a ball joint of the type specified wherein low friction synthetic plastics bearing material is injection moulded between the housing and ball element, whilst the latter are held in their correct relative assembly positions, to form a seating socket in the housing around the ball element, and the said closure member is applied to the open housing end behind the socket, after the latter has set, to confine the socket between the closure member and the mouth shoulder under a compressive force sufficient to pre-load the joint.

2. A method as claimed in claim 1, wherein injection moulding is effected by a die or plug having an injection moulding orifice opening through a working face thereof which covers the open end of the housing remote from the housing mouth and serves to determine the form of the adjacent socket end, the said die or plug being located against an internal ledge formed within the housing.

3. A method as claimed in claim 1 or claim 2, wherein a pre-formed washer made of nylon or other appropriate low friction plastics material is arranged to form a stop or closure around the housing mouth during injection moulding, said washer being retained in the completed joint and being shaped to provide an inner seating edge which makes wiping contact around the ball element near the root end of the ball pin and an angled outer edge which seats snugly under the shoulder of the housing mouth.
4. A method as claimed in claim 1 or claim 2, wherein an annular die or plug is arranged around the ball pin during the injection moulding to close off the housing mouth between the innermost edge of the mouth shoulder and the periphery of the ball element adjacent the root end of the pin.
5. A method as claimed in claim 4, wherein the shoulder at the housing mouth is internally recessed so that projections are formed around the socket mouth, during the injection moulding, which enter the recesses and prevent relative rotation between the socket and housing.
6. A method as claimed in any of claims 2 to 5, wherein the closure member is provided with an edge part which is located against said internal housing ledge and a centre part which transmits bearing pressure to the socket end remote from the mouth.
7. A method as claimed in claim 3, wherein the pre-formed washer is formed as an integral rim on one end of a flexible sleeve-type dust excluder, the other end of which is arranged to embrace the projecting ball pin.
8. A method as claimed in any of claims 2 to 7, wherein the working face of the injection die is shaped to form the external surface of the adjacent socket end with a flat margin around the edge thereof which lies substantially flush with the aforesaid locating ledge within the housing and a central part-spherical or flat portion which projects beyond said ledge to receive pressure from the end closure member.
9. A method as claimed in any of claims 2 to 8, wherein the working face of the injection die is shaped to provide the adjacent socket end with a central opening therethrough.
10. A method as claimed in any of claims 2 to 9, wherein the closure member is given a plate- or dish-like form depending upon the shaping of the adjacent socket end.
11. A method as claimed in claim 10 wherein the closure member is arranged to exert pressure on the adjacent socket end through the intermediary of a deformable disc-like or spring insert.
12. A method as claimed in claim 10 or claim 11, wherein the closure member is secured in position behind the socket by peening over the housing edge behind said closure member or by means of co-operating screw-threads on the closure member and housing.
13. A method as claimed in any of claims 1 to 12, wherein the injected material is nylon, polypropylene, any of the poly iso-cyanate condensation products or a material incorporating polytetrafluoroethylene.
14. A method as claimed in any of claims 1 to 13, wherein a low friction woven material, which may incorporate polytetrafluoroethylene, is placed around the ball element in the manner of a sock and the plastics seating is then moulded around this woven material.
15. A method as claimed in any of claims 1 to 14, wherein lubricant is inserted into the joint before the closure member is fitted and the seating socket is provided with one or more lubricant passages to permit such lubricant to reach the surface of the ball element.
16. The improved method of making a ball joint substantially as hereinbefore described with reference to any of the Figures of the accompanying drawing.
17. A ball joint made by the method claimed in any of the foregoing claims or substantially as described herein with reference to any of the Figures of the accompanying drawing.
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COMPLETE SPECIFICATION

1 SHEET

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